CHAPTER III
WITHOUT-PROJECT CONDITIONS

One of the most important elements of any water resource evaluation is defining the scope of problems needing to be solved and opportunities to be addressed. Significant in this process is defining existing resource conditions and how those conditions may change in the future. The magnitude of this change not only influences the scope of the problems, needs, and opportunities, but the extent of related resources that could be influenced by possible actions to address them. Accordingly, presented below is a brief assessment of existing and estimated future without-project conditions in the primary and extended study area. Additional information is provided in Appendix A (Supplemental Information for Existing Conditions). This information will continue to be developed as the feasibility study progresses.

EXISTING CONDITIONS

Shasta Dam and Reservoir Project

Existing Water Control Facilities

Shasta Dam is a curved, gravity-type, concrete structure 533 feet high above the stream-bed with a total height above the foundation of 602 feet. Lake Shasta has a storage capacity and water surface area at gross pool of 4,552,000 acre-feet and 29,600 acres, respectively. The seasonal flood control storage space in Shasta is 1.3 MAF. Shasta Dam has a crest width of about 41 feet and a length of 3,460 feet. The Shasta Powerplant consists of five main generating units and 2 station service units with a combined capacity of 652,000 kilowatts. **Table 1** summarizes the major pertinent data and features of Shasta Dam and Reservoir. **Plates 4 and 5** show several elevation, section, and plan views of Shasta Dam and Powerplant. These drawings were prepared prior to the construction of the existing temperature control facilities on the upstream face of the dam. **Plate 6** shows the relationship between reservoir surface area and storage capacity at various water surface elevations**.**

Keswick Dam is about 9 miles downstream from Shasta Dam and, in addition to regulating the outflow from the dam, controls the runoff from an additional 45 square-miles of drainage area. Keswick Dam is a concrete, gravity-type structure with a spillway over the center of the dam. The spillway has four 50- by 50-foot fixed wheel gates with a combined discharge capacity of 248,000 cfs at full or gross pool elevation (587 feet). The storage capacity below the top of the spillway gates at gross pool is 23,800 acre-feet. The power plant has a nameplate generating capacity of 75,000 kilowatts and can pass about 15,000 cfs at gross pool.

The existing temperature control device (TCD) at Shasta was constructed between 1996 and 1998. It is a multi-level water intake structure located on the upstream face of the dam. The TCD allows operators to draw water from the top of the reservoir during the winter and spring when the surface water temperatures are cool, and from deeper in the reservoir in the summer and fall when the surface water is warm. It also improves oxygen and sediment levels in the downstream river water. The TCD helps Reclamation fulfill contractual obligations for both water delivery and power generation while benefiting fish that require cooler water temperatures, such as salmon.

TABLE 1
PERTINENT DATA – SHASTA DAM AND RESERVOIR

GENERAL			
Drainage Areas (excluding Goose Lake Basin)		**Mean Annual Runoff (1908-1974)**	
Sacramento R. at Shasta Dam	6,421 sq-mi	Sacramento R. at Shasta Dam	5,737,000 ac-ft
Sacramento R. at Keswick	6,468 sq-mi	Sacramento R. near Red Bluff	8,421,000 ac-ft
Sacramento R. above Bend		Sacramento R. at Ord Ferry	9,812,000 ac-ft
Bridge near Red Bluff	8,900 sq-mi	**Maximum Flows of Record (1903-1976)**	
Sacramento R. near Ord Ferry	12,250 sq-mi	Sacramento R. at Shasta Lake	
Pit R. at Big Bend		16 Jan 1974	216,000 cfs
	4,710 sq-mi	Sacramento R. near Red Bluff	
McCloud R. above Shasta Lake	604 sq-mi	28 Feb 1940	291,000 cfs
Sacramento R. at Delta	425 sq-mi	Sacramento R. at Ord Ferry	
		28 Feb 1940	370,000 cfs
SHASTA DAM AND LAKE			
Shasta Dam (concrete gravity)		**Shasta Lake**	
Crest elevation	1077.5 ft	Elevations msl	
Freeboard above gross pool	9.5 ft	Gross pool	1067.0 ft
Height above foundations	602 ft	Minimum operating level	840.0 ft
Height above streambed	487 ft	Taking line	Irregular
Length of crest	3500 ft	Area	
Width of crest	30 ft	Minimum operating level	6,700 acres
Slope, upstream	Vertical	Gross pool	29,500 acres
Slope, downstream	1 on 0.8	Taking line	90,000 acres
Volume	8,430,000 cu yd	Storage capacity	
Normal tailwater elevation	585 ft	Minimum operating level	587,000 ac-ft
Spillway (gated ogee)		Gross pool	4,552,000 ac-ft
Crest length		**Shasta Power Plant**	
Gross	360 ft	Main units	
Net	330 ft	5 turbines, Francis type,	
Crest gates (drum type)		total capacity	515,000 hp
Number and size	3 @ 110' x 28'	5 generators, 125,000 kw each	
Top elevation when lowered	1037.0 ft	total capacity	625,000 kw
Top elevation when raised	1065.0 ft	Station units	
Discharge capacity at pool elevation 1065 ft	186,000 cfs	2 generators, 2,000 kw each total capacity	4,000 kw
Flashboard gates		Elevation centerline turbines	586 ft
Number and size	3 @ 110' x 2'	Maximum tailwater elevation	632.5 ft
Top elevation when lowered	1067.0 ft	Total discharge capacity at pool	
Bottom elevation when raised	1069.5 ft	elevation 1065 ft	14,500 cfs
		Total discharge capacity at pool	
Outlets		elevation 827.7 ft	16,000 cfs
River outlets (102 in. dia. Conduit			
with 96 in. dia. Wheel type gate)			
4 with invert elevation	737.75 ft		
8 with invert elevation	837.75 ft		
6 with invert elevation	937.75 ft		
Capacity at elevation 1065 ft	81,800 cfs		
Capacity at elevation 827.7 ft	12,200 cfs		
Power outlets (15' steel penstocks)			
5 with invert elev. of intake	807.5 ft		
KESWICK DAM AND RESERVOIR			
Keswick Dam (concrete gravity)		**Keswick Reservoir**	
Crest elevation	595.5 ft	Elevation msl	
Freeboard above maximum		Maximum operating level	587.0 ft
operating level	8.5 ft	Minimum operating level	574.0 ft
Height of dam above foundation	159 ft	Area at maximum operating level	643 acres
Height of dam above streambed	119 ft	Storage capacity	
Length of crest	1046 ft	At maximum operating level	23,800 ac-ft
Width of crest	20 ft	At minimum operating level	16,300 ac-ft
Volume	197,000 cu-yd	**Keswick Power Plant**	
Normal tailwater elevation	487 ft	Generator capacity, 3 units	75,000 kw
Spillway (gated ogee)			
Crest length			
Net	200 ft		
Crest gates (fixed wheel)			
Number and size	4 @ 50' x 50'		
Discharge capacity at pool elevation 587 ft	248,000 cfs		

Recreation Facilities

The Whiskeytown-Shasta-Trinity National Recreation Area was established by Act of Congress in November 1965. The area comprises three separate units: Whiskeytown Lake, Shasta Lake, and Clair Engle-Lewiston Lakes. The Shasta Unit and the Clair Engle-Lewiston Unit are within the Shasta-Trinity National Forest and are administered by the U.S. Forest Service (FS). The Whiskeytown Unit is administered by the National Park Service. Facilities provided by the FS at Shasta Lake include twenty-nine campgrounds, four boat-launching ramps and two beach and picnic areas. In addition to the FS facilities, about eighteen resorts and marinas are operating under permit within the Shasta Lake Unit. Facilities provided by these permit-holders include rental housing, stores, snack bars, restaurants, excursion boats, boat-dock service and rental, camping areas and boat-launching ramps. A map showing locations of the major recreation facilities in the Shasta Unit of the Whiskeytown-Shasta Trinity National Recreation area are shown on **Plate 7**.

Major Reservoir Area Infrastructure

An inventory of infrastructure in the Shasta Reservoir area was conducted to identify features that could be subject to modification or relocation if Shasta Dam were raised up to 30 feet. The inventory was conducted from the existing gross pool elevation of 1,067 feet msl (1,070 feet under NAVD 1988 datum) to 1,097 feet msl. Over four hundred items were included in the infrastructure inventory, as summarized in **Table 2**.

TABLE 2
SUMMARY OF FACILITIES FROM EXISTING GROSS POOL TO ELEVATION 1,100 FEET

Facilities	Number
Buildings	197
Bridges	22
Dams	2
Paved Road Segments	86
Unpaved Road Segments	53
Parking Areas	16
Railroad Segments	1
Power Towers	3
Miscellaneous Objects	23
Total Items	***403***

At least one-fourth of the buildings potentially affected are homes or cabins, more than one-third are associated with private resorts or marinas, and an estimated ten percent are associated with FS facilities such as campgrounds, boat ramps, and stations. Some businesses and community buildings would also be potentially affected in Lakeshore. Ten of the twenty-two bridges in the reservoir area carry the Union Pacific Railroad; two of the bridges are on Interstate 5; one of the bridges (Pit River Bridge) carries both Interstate 5 and the Union Pacific Railroad; three of the bridges are maintained by Shasta County; and six of the bridges are maintained by the FS. Not all of the twenty-two bridges identified in the inventory would need to be relocated. Of the almost thirty campgrounds, half are either shoreline campsites or boat camps with no significant infrastructure. The developed campgrounds would be impacted by various amounts with a 30-foot raise in the reservoir.

The most significant pieces of infrastructure that would be affected by a raise of 30 feet are:

- The Pit River Bridge (Interstate 5 and Union Pacific Railroad),

- The Union Pacific Railroad between tunnels 1 and 2 (0.6 miles south of the Pit River Bridge),

- The Interstate 5 Bridge over the Sacramento River in the Lakeshore/Antlers area (and approximately 2,000 feet of Interstate 5 at Lakeshore, just north of the bridge),

- Several homes in the communities of Lakeshore and Sugarloaf, and

- The Pit 7 Dam (owned by PG&E).

Plate 8 shows a plan and profile view of the Pit River Bridge. The Pit River Bridge is the most significant structure within the inventory range. The Shasta Reservoir Area Inventory Office Report is included as Appendix B.

Physical Environment

Topography

Shasta Dam and Reservoir are located on the northern edge of California's Central Valley, which is almost completely enclosed by mountains and has only one outlet, through the San Francisco Bay to the Pacific Ocean. The valley is nearly 500 miles long and averages 120 miles in width. The Central Valley is drained by the Sacramento River in the northern portion and the San Joaquin River and Tulare Lake tributary streams in the southern portion.

The major tributary drainages above Shasta Dam, the Sacramento, McCloud, and Pit rivers, and several smaller drainages, originate in the east and flow generally westward into Shasta Lake. Downstream from the dam, the Sacramento River travels south to the Delta, picking up additional flows from numerous tributaries including Cottonwood Creek, Stony Creek, the Feather and American rivers, and others. The Sacramento River Basin covers approximately 27,000 square miles and is about 240 miles long and up to 150 miles wide.

Ground surface elevations in the northern portion of the Sacramento Valley range from above14,000 feet at Mount Shasta in the headwaters of the Sacramento River to approximately 1,070 feet at Shasta Lake. About 65 percent of the mountainous area within this range lies below 4,000 feet in elevation and 97 percent below 7,000 feet in elevation. Other mountain areas bordering the valley reach elevations higher than 10,000 feet. In the southern portion of the Sacrament River Basin, the Sacramento Valley floor is relatively flat.

Geology

The geologic provinces composing the Sacramento River region include the Klamath Mountains, the Coast Ranges, the Cascade/Modoc Plateau, the Sierra Nevada, and the Central Valley. Shasta Lake is located within the Klamath Mountain geomorphic province in the north end of the Sacramento Valley. The Klamath Mountain province is considered to be a northern extension of the Sierra Nevada. It consists of rugged topography with prominent peaks and ridges. The drainage of this province is primarily through the Klamath and the upper Sacramento rivers. Rocks include pre-Cretaceous metamorphic, abundant serpentine, and granitics.

The Central Valley province (also referred to as the Great Valley) is a large, asymmetrical, northwestwardly trending, structural trough formed between the uplands of the California Coast Ranges to the west and the Sierra Nevada to the east. This trough has been filled with a tremendously thick sequence of sediments ranging in age from Jurassic to Recent.

Soils

The soils of the Sacramento River Basin are divided into four physiographic groups: upland soils, terrace soils, valley land soils, and valley basin soils. Upland soils are prevalent in the hills and mountains of the region and are composed mainly of sedimentary sandstones, shales and conglomerates of igneous rocks. Terrace and upland soils are predominant between Redding and Red Bluff, however, valley land soils border the Sacramento River through this area. Valley land and valley basin land soils occupy most of the Sacramento Valley floor south of Red Bluff. Valley land soils consist of deep alluvial and aeolian soils that make up some of the best agricultural land in the State. The valley floor was once covered by an inland sea and soils were formed by deposits of marine silt followed by mild uplifting earth movements. After the main body of water disappeared, the Sacramento River began eroding and redepositing silt and sand in new alluvial fans.

Geomorphology

The geomorphology of the Sacramento River is a product of several factors: the geology of the Sacramento Valley, hydrology and climate, vegetation, and human activity. Large flood events drive lateral channel migration and remove large flow impediments. Riparian vegetation stabilizes stream banks and reduces water velocities, inducing deposition of eroded sediment. In the past, a balance existed between erosion and deposition along the Sacramento River. However, the construction of dams, levees, and water projects has altered stream flow and other hydraulic characteristics of the Sacramento River. In some areas, human-induced changes have stabilized and contained the river, while in other reaches the loss of riparian vegetation has reduced sediment deposition and led to increased erosion.

The upper Sacramento River between Shasta Lake and Red Bluff is bounded and underlain by resistant volcanic and sedimentary deposits that confine the river, resulting in a relatively stable river course. This reach of river is characterized by steep vertical banks and the river is primarily confined to its channel with limited overbank floodplain areas. There is limited meander of the river above Red Bluff. Downstream from Red Bluff, the Sacramento River is active and sinuous, meandering across alluvial deposits within a wide meander belt. Geologic outcroppings and man-made structures, such as bridges and levees, act as local hydraulic controls along the river. Bank protection, consisting primarily of rock riprap, has been placed along various sections of the Sacramento River to prevent erosion and river meandering.

Sedimentation and Erosion

Sedimentation and erosion are natural processes throughout the primary and extended study areas. These processes have been affected by a number of factors, including hydraulic mining; construction of dams, reservoirs, and channel modifications; and agriculture and urban activities.

The watershed above Shasta Lake is generally well forested and erosion is not excessive. However, landslides are relatively common as much of the area is steep. Slides and sheetwash supply debris and bedload sediments to the tributary streams of Shasta Lake. Many of the reservoir tributaries are well-balanced systems where flows and bedload are in dynamic equilibrium.

Shasta and Keswick Dams effect sediment transport as they block the sediments that would normally have been transported from the upper Sacramento River Basin. The result has been a net loss of coarse sediment in the Sacramento River below Keswick Dam that has negatively impacted spawning gravels. In alluvial river sections, bank erosion and sediment deposition cause migrations of the river channel that are extremely important in maintaining instream and riparian habitats, but can also cause loss of agricultural lands and damage to roads and other structures. In the Sacramento River, these processes are most important in the major alluvial section of the river, which begins downstream from the RBDD. The river channel in the Keswick to RBDD reach is more constrained by erosion-resistant volcanic and sedimentary formations and, therefore, is more stable.

Hydrology

The Sacramento River Basin contains the entire drainage area of the Sacramento River and its tributaries and extends almost 300 miles from Collinsville in the Delta north to the Oregon border. Hot, dry summers and mild winters characterize the valley floor. Total annual precipitation at higher elevations averages between 60 and 70 inches and is as high as 95 inches in the northern Sierra Nevada and the Cascade Range. Precipitation on the valley floor occurs mostly as rain, and yearly totals range from 20 inches in the northern end of the valley to about 15 inches at the Delta. Average annual precipitation throughout the Sacramento River Basin is 36 inches. The most intensive runoff occurs in the upper watershed of the Sacramento River above Lake Shasta and on the rivers originating on the west slope of the Sierra Nevada. These watersheds produce an annual average of 1,000 to more than 2,000 acre-feet of runoff per square mile.

The Sacramento River contributes the majority of Delta inflow. Unimpaired flow from the four major rivers in the Sacramento River Basin (Sacramento, Feather, Yuba, and American rivers) averaged 21.2 MAF and ranged from about 5 to 38 MAF during the 1906-1996 period. Of this, the Sacramento River (at Red Bluff) averaged 8.4 MAF (including Trinity River imports, described below), the Feather River averaged 4.5 MAF, the Yuba River averaged 2.4 MAF, and the American River averaged 2.6 MAF.

Mean monthly inflows, outflows, and storages at Shasta Reservoir are shown in **Table 3**. As can be seen, the highest average monthly inflow period for Shasta is January through March. Winter and early spring inflows are stored for later release during the summer irrigation season.

Since 1964, a portion of the flow from the Trinity River Basin has been exported to the Sacramento River Basin through CVP facilities, as shown in **Figure 2**. Historically, an average annual quantity of 1.27 MAF of water has been exported. This annual quantity is approximately 17 percent of the flows measured in the Sacramento River at Keswick Dam. As mentioned, however, Trinity River diversions to the Sacramento River are to be reduced as part of the December 2002 ROD to allow more inflows to remain in the Trinity River for fish restoration purposes.

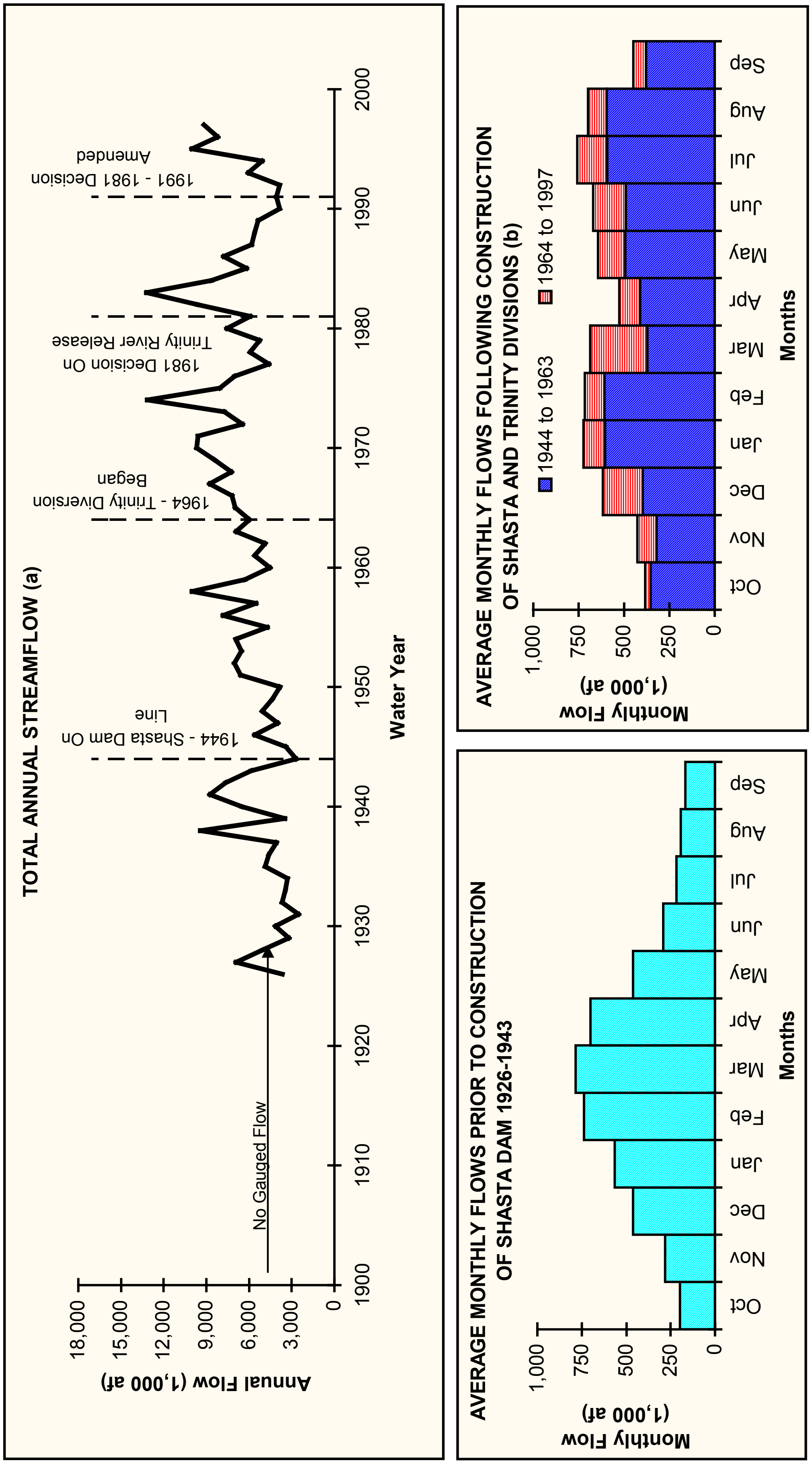
TABLE 3
MEAN MONTHLY INFLOW TO SHASTA RESERVOIR

Month	Inflow [1] (1,000 Acre-Feet)	Outflow [2] (1,000 Acre-Feet)	Shasta Storage [3] (1,000 Acre-Feet)
January	799	587	3,131
February	836	628	3,355
March	889	511	3,719
April	693	421	3,961
May	537	524	3,948
June	339	536	3,720
July	247	615	3,326
August	223	571	2,966
September	220	377	2,809
October	263	301	2,775
November	365	331	2,801
December	585	465	2,906
Total	***5,991***	***5,868***	***NA***
Average	***499***	***489***	***3,285***

Notes:
1. *Computed data based on a period from 1944 to 2002.*
2. *Recorded data based on a period from 1944 to 2002.*
3. *Shasta storage data computed based on a period from 1953 to 2002.*

Flood Control

A number of flood management projects along the Sacramento River affect the flow and operation of facilities, including dams and reservoirs, levees, and weirs. Major reservoirs in the Sacramento River watershed and flood control storage space include Folsom Reservoir on the American River, Lake Oroville on the Feather River, Black Butte Reservoir on Stony Creek, and Shasta Reservoir. Other major flood management system facilities include five weirs located along the Sacramento River to divert part of the floodflows to the overflow basins and bypasses (Butte Basin, Sutter Bypass, and Yolo Bypass). The weirs allow high Sacramento River flow to enter the basin and bypass the system. The weirs were designed to begin operation in a certain order: Tisdale Weir, Colusa Weir, Fremont Weir, Moulton Weir, and Sacramento Weir.



Notes
(a) First full year of stream flow data for station 11370500 was 1939. Data for 1926-1963 are from Station 1136950.
(b) Upper portion of bar represents incremental increase in average monthly flows since 1964 water year, when releases through Spring Creek Powerplant.

Figure 2 – Historical streamflow in the Sacramento River below Keswick Dam.

The flood management system of the San Joaquin River Basin includes levees along the lower portions of Ash and Berenda sloughs; Bear Creek; Fresno and Stanislaus rivers; and leveed sections along the San Joaquin River. The Chowchilla Canal Bypass diverts San Joaquin River flow excess and sends it to the Eastside Bypass. In addition to the Chowchilla Canal Bypass, the Eastside Bypass intercepts flows from minor tributaries and rejoins the San Joaquin River between Fremont Ford and Bear Creek. The San Joaquin River levee and diversion system is not designed to contain the objective release from each of the project reservoirs simultaneously.

The primary non-Federal sponsor for flood control projects in both the Sacramento and San Joaquin River basins is the Reclamation Board of the State of California. The Reclamation Board has signed onto the assurances of operating and maintaining the Federal project under the authority of the Flood Control Act of 1944. The Reclamation Board has local agreements with the DWR, levee districts, reclamation districts, and other entities. These local agreements share operation and maintenance requirements with the Reclamation Board. Because reclamation districts and other local entities do the actual maintenance and operation for sections of the flood control project, maintenance practices vary from almost no maintenance to outstanding maintenance. The quality of maintenance normally depends on the funding availability to the maintaining entity, which varies widely.

Maintaining the flood management system levees and channels is difficult due to the erosive nature of the flood flows that the current system configuration produces, and due to expensive, environmental mitigation when bank protection is required. The system is tightly leveed in many locations and the levees must be continually protected from erosion. The most common material used is rock riprap, which effectively prevents erosion but negatively impacts riparian habitat. Mitigation costs for new flood control projects and improvements have constantly increased over the past decades due to environmental awareness.

The current regulation of Shasta Dam for flood control requires that releases be restricted to quantities that will not cause downstream flows or stages to exceed, insofar as possible (1) a flow of 79,000 cfs at the tailwater of Keswick Dam and (2) a stage of 39.2 feet at the Sacramento River at Bend Bridge gaging station near Red Bluff (corresponding roughly to a flow of 100,000 cfs). **Plates 9 and 10** show peak flow-frequency relationships at both Keswick and Bend Bridge. A storage space of up to 1.3 MAF below gross pool elevation of 1,067 feet is also kept available for flood control purposes in the reservoir in accordance with the Flood Control Diagram (see **Plate 11**), as prescribed by the Corps. Under the diagram, flood control storage space increases from zero on October 1 to 1.3 MAF (elevation 1,018.55) on December 1 and is maintained until December 23. From December 23 to June 15, the required flood control space varies according to parameters based on the accumulation of seasonal inflow. This variable space allows for the storage of water for conservation purposes, unless it is required for flood control purposes based upon basin wetness parameters and the level of seasonal inflow. Daily flood control operation consists of determining the required flood storage space reservation and scheduling releases in accordance with flood operating criteria.

Flood control operations of Shasta Dam require forecasting of flood runoff both above and below the dam. Rapidly changing inflows are continually monitored, and the forecasts of the various inflows are adjusted as required. The time of streamflow travel from Shasta Dam to Bend Bridge is about 9 to 10 hours under higher flow conditions. The timing of peak reservoir inflows and peak inflows from tributaries downstream from the dam can complicate release operations. The large size of the flood control pool at Shasta Reservoir can prolong flood release operations for many weeks as operators vacate the pool before the next storm event.

As indicated, a goal of the existing operation is to have in excess of the required flood control space vacant in the flood season and then fill the pool to the maximum extent possible for water supply and other needs in the remainder of the year. **Plate 12** is a plot showing the historical monthly storage in Shasta Reservoir for the period of 1953 through 2002. As can be seen, in most years Shasta Reservoir has been able to fill following the flood season drawdown.

Table 4 shows the total annual inflows to Shasta Reservoir for the period 1945 through 2002. Also shown is the end of water year (September 30) storage and those years in which a release was needed from Shasta Dam for flood control. Releases for flood control could either be in the fall to reach the prescribed vacant flood space beginning in early October or to evacuate space during or after a storm event.

Figure 3 shows the estimated frequency (percent exceedance) of storage in Shasta Reservoir for the end of September. As can be seen, the average storage in the reservoir (50 percent exceedence) under existing conditions prior to the beginning of flood control operations is about 2.7 MAF. The frequency distribution graph also shows that in about 80 percent of the years, the end of September stage is greater than about 1.9 MAF, and 3.3 MAF in about 20 percent of the years.

As mentioned, the estimated safe channel carrying capacity of the Sacramento River downstream from Keswick through Redding is 79,000 cfs. Shasta Dam and Reservoir can control outflows from Keswick to that value from about the 1.3 chance in 100 to 1.0 chance in 100 in any one year (see **Plate 9**) if it is operated precisely according to the Flood Control Manual. For flood events rarer than about the 1.0 chance in 100 in any one year, inflows to Shasta would exceed the ability of the reservoir to store the inflow volume and maintain the 79,000 cfs channel capacity. Under these circumstances, the outflows from the dam would need to be increased to prevent uncontrolled conditions (see **Plate 9**).

Shasta Lake collects flow in the upper Sacramento River watershed, but many uncontrolled tributaries enter the Sacramento River downstream from the dam. Stream gages have been added to the major uncontrolled tributaries entering downstream from Shasta Lake (Cow, Battle, Cottonwood, and Thomes creeks). To a limited extent, the operators of Shasta Dam can adjust releases containing these uncontrolled flows to try to reduce downstream peak flows. Accordingly, the influence of Shasta's operation on reducing peak flood flows diminishes downstream on the Sacramento River.

TABLE 4
SHASTA DAM AND RESERVOIR FLOOD CONTROL RELEASES

Water Year	Total Annual Inflow (1,000 Ac-Ft)	End of September Storage (1,000 Ac-Ft)	Flood Release?		Reason	Water Year	Total Annual Inflow (1,000 Ac-Ft)	End of September Storage (1,000 Ac-Ft)	Flood Release?		Reason
			Yes	No					Yes	No	
1945	4,858			X	Initial Filling	1974	10,796	3,658	X		
1946	5,905			X		1975	6,405	3,570	X		
1947	3,907			X		1976	3,611	1,295	X		Nov/Dec Drawdown
1948	5,416			X		1977	2,628	631		X	
1949	4,368			X		1978	7,837	3,428	X		
1950	4,134			X		1979	4,022	3,141		X	
1951	6,316			X		1980	6,415	3,321	X		
1952	7,786			X		1981	4,103	2,480	X		
1953	6,541	3,300	X			1982	9,013	3,486	X		
1954	6,540	3,059	X			1983	10,794	3,617	X		
1955	4,112	2,455		X		1984	6,667	3,240	X		
1956	8,831	3,569	X			1985	3,971	1,978	X		Nov/Dec Drawdown
1957	5,369	3,485	X			1986	7,546	3,211	X		
1958	9,700	3,473	X			1987	3,944	2,108		X	
1959	5,086	2,504	X			1988	3,931	1,586		X	
1960	4,733	2,756		X		1989	4,745	2,096		X	
1961	5,073	2,333	X			1990	3,616	1,637		X	
1962	5,261	2,908	X			1991	3,051	1,340		X	
1963	7,002	3,242	X			1992	3,622	1,683		X	
1964	3,905	2,202		X		1993	6,825	3,102	X		
1965	6,983	3,612	X			1994	3,087	2,102		X	
1966	5,299	3,263	X			1995	9,638	3,136	X		
1967	7,404	3,506	X			1996	6,846	3,089	X		
1968	4,772	2,670	X			1997	7,424	2,308	X		
1969	7,667	3,528	X			1998	10,294	3,441	X		
1970	7,901	3,440	X			1999	7,196	3,328	X		
1971	7,327	3,275	X			2000	6,839	2,985	X		
1972	5,078	3,267	X			2001	4,141	2,200		X	
1973	6,167	3,317	X			2002	5,052	2,558		X	
Average							***5,991***	***2,430***			
Total - In Period (1945-2002)									***36***	***22***	
Total - Outside Filling Period (1953-2002)									***36***	***14***	
Percent of Years (Outside Filling Period)									***72***	***28***	

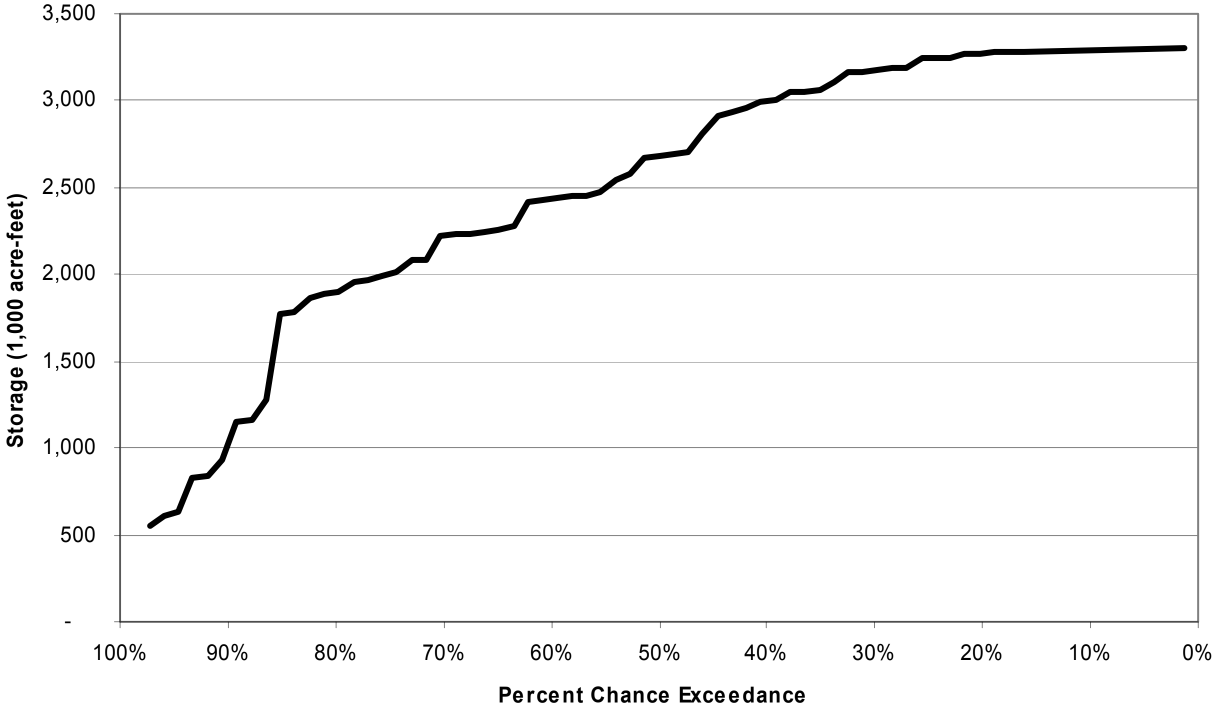


Figure 3 – Estimated Frequency (Percent Chance Exceedance) of Storage at the End of September in Shasta Reservoir with 2000 Level Demands and D-1641 Requirements

Water Quality

The SWRCB and the regional water quality control boards largely determine objectives for water quality in California's surface waters. The project area lies entirely within the region under jurisdiction of the Central Valley Regional Water Quality Control Board (CVRWQCB). The water quality objectives for a particular reservoir or river reach are affected by its beneficial uses, which are determined by the CVRWQCB. The water quality must adequately protect the beneficial uses. The beneficial uses for Shasta Lake and its tributaries, and the reach of the Sacramento River between Shasta Dam and the Colusa Drain (which includes Keswick Reservoir and the river between Keswick Dam and the RBDD) are provided in **Table 5**.

Water quality in the project area generally supports the beneficial uses of the area's rivers and reservoirs. However, impaired water quality conditions have been found for specific waters of the project area in the recent past and some of these impaired conditions persist. The principal water quality issues for the project area include water temperatures in the Sacramento River between Keswick Dam and the RBDD, turbidity in Shasta Lake, and acid mine drainage and associated heavy metal contamination from the Spring Creek drainage and other abandoned mining sites. Elevated pesticide levels have been found at some sites in the Sacramento River Valley for a number of years, but these sites are downstream from Red Bluff. Storm water runoff from Redding and other urban areas likely flushes contaminants into the Sacramento River, but the volume of flow in the river generally provides sufficient dilution to prevent excessive concentrations in the river. The City of Redding is working toward compliance under Phase II of the National Pollution Discharge Elimination System (NPDES).

TABLE 5
BENEFICIAL USES FOR THE SURFACE WATERS IN THE PROJECT AREA

Beneficial Use	Pit River (Hat Creek to Shasta Lake)	McCloud River	Sacramento River, Box Canyon Dam to Shasta Lake	Shasta Lake	Sacramento River (Shasta Dam to Colusa Drain)
Municipal & domestic supply (drinking water)	E*	E		E	E
Agriculture, irrigation	E		E	E	E
Agriculture, stock watering	E		E		E
Industry, Service Supply					E
Industry, Power	E	E		E	E
Recreation, contact	E	E	E	E	E
Recreation, whitewater	E	P	P		E
Recreation, noncontact	E	E	E	E	E
Freshwater habitat, warm	P			E	P
Freshwater habitat, cold	E	E	E	E	E
Migration, warm					E
Migration, cold					E
Spawning, warm	E			E	E
Spawning, cold	E	E	E	E	E
Wildlife habitat	E	E	E	E	E
Navigation					E

** E refers to an existing beneficial use, P refers to a potential beneficial use*

Air Quality

The northern half of the Central Valley is located in the Sacramento Valley Air Basin (SVAB). The Coast Range, the Sierra Nevada Range, the Cascade Mountains, and the San Joaquin Valley Basin bound the basin. Marine winds enter the valley at the Carquinez Straits and head eastward until deflected north into the Sacramento Valley and south into the San Joaquin Valley. A combination of air contaminants, meteorological conditions, and the topographic configuration of the valley affect air quality throughout the Sacramento Valley Basin. Most of the air pollutants in the study area may be associated with either urban or agricultural land uses.

During the summer, the Pacific high-pressure systems can create inversion layers in the lower elevations that prevent the vertical dispersion of air. As a result, air pollutants can become concentrated during the summer, lowering air quality. During the winter, when the Pacific high-pressure system moves south, stormy, rainy weather intermittently dominates the region. Prevailing winter winds from the southeast disperse pollutants, often resulting in clear, sunny weather and better air quality over most of the region. Much of the SVAB is designated as a non-attainment area with respect to the national and State ozone (O_3) and particulate matter (PM_{10}) standards, and the urban Sacramento and Maryville/Yuba City area are designated as non attainment for national and State carbon monoxide (CO) standards.

The relatively low residential density of Shasta County’s rural and suburban residential areas contributes to an auto-dependent life-style that affects quality. Pollution from mobile sources, such as cars and trucks, represents 43 percent of hydrocarbons emissions, 57 percent of nitrogen oxide (NO) emissions, 59 percent of reactive organic gases and 82 percent of CO emissions in typical urban areas of Shasta County (Shasta County General Plan). There are many other sources of air pollution in the study area (i.e., residential, agriculture, and forest management burn practices, imported pollutants from lower Sacramento Valley, unpaved roads, etc.).

Noise

Noise levels in densely populated areas of the State are influenced predominantly by the presence of limited-access highways carrying extremely high volumes of traffic, particularly heavy trucks. Noise in rural areas in which traffic generally is low to moderate is measured at considerably lower decibels. Noise at Shasta Lake is affected by the presence of boats for water skiers and personal watercraft.

Biological Environment

Biological resources in the region are resultant of a wealth and diversity of climatic and vegetative associations within and adjacent to the project area. Influences from the coastal mountains, southern Cascades, northern Sierra Nevada, Great Basin and Central Valley provide for a unique mix of biota.

Much of the area, especially that within the Central Valley, has been modified by past and present land uses. Prior to human settlement, this region was dominated by riparian vegetation within the annual floodplains, with stands of valley oak and interior live oak on higher ground. Herbaceous wetland bottoms and upland native grassland communities were common in this vegetation mosaic. The extensive oak forests and riparian/wetland habitats hosted a diverse and abundant wildlife community. Cattle grazing, deforestation of the oak woodlands, and flood protection resulting in expansion of agriculture onto the floodplains in the early to mid-1800's substantially altered both the floodplain and channel vegetation. Agriculture is currently the primary land use in the Central Valley, with the riparian vegetation relegated to narrow strips along portions of the main channel and its tributaries.

Aquatic and Fishery Resources

The fish species assemblages of the Sacramento River include anadromous and resident salmonids and native warm-water river species such as Sacramento sucker and Sacramento pike minnow. The Shasta Lake and Keswick Reservoir fish species include mostly introduced warm-water and cold-water species. The Shasta Lake tributary species include planted and wild trout and several native species. The major non-fish aquatic animal species assemblages of the project area are the benthic macroinvertebrates of Shasta Lake, the Sacramento River and the tributaries to Shasta Lake, and the zooplankton of the reservoirs. **Table 6** gives the common and scientific names of the fish species found in the project area and their likely locations.

TABLE 6
FISH SPECIES KNOWN TO OCCUR IN THE PROJECT AREA

Common Name	Scientific Name	Shasta Lake Tributaries	Shasta Lake / Keswick Reservoir	Sacramento River - Keswick to Red Bluff
Chinook salmon	*Oncorhynchus tshawytscha*			
winter-run				X
spring-run				X
fall-run			X	X
late fall-run				X
Kokanee salmon	*Oncorhynchus nerka*	X	X	
Rainbow trout	*Oncorhynchus mykiss*	X	X	X
Steelhead trout	*Oncorhynchus mykiss*			X
Brown trout	*Salmo trutta*	X	X	
Green sturgeon	*Acipenser medirostris*			X
White sturgeon	*Acipenser transmontanus*	X	X	X
Pacific lamprey	*Lampetra tridentata*			X
Western brook lamprey	*Lampetra richardsoni*			X
Sacramento sucker	*Catostomus occidentalis*	X	X	X
Sacramento pikeminnow	*Ptychocheilus grandis*	X	X	X
Hardhead	*Mylopharodon conocephalus*	X	X	X
Sacramento blackfish	*Orthodon microlepidotus*	X	X	
California roach	*Hesperolecus symmetricus*	X		X
Speckled dace	*Rhinichthys osculus*	X	X	
Golden shiner	*Notemigonus crysoleucas*	X	X	
Carp	*Cyprinus carpio*	X	X	X
Channel catfish	*Ictalurus punctatus*	X	X	X
White catfish	*Ameiurus catus*		X	X
Brown bullhead	*Ameiurus nebulosus*		X	X
Black bullhead	*Ameiurus melas*		X	X
Riffle sculpin	*Cottus gulosus*	X	X	
Prickly sculpin	*Cottus asper*			X
Largemouth bass	*Micropterus salmoides*		X	
Smallmouth bass	*Micropterus dolomieui*	X	X	X
Spotted bass	*Micropterus punctulatus*	X	X	
Black crappie	*Pomoxis nigromaculatus*		X	
White crappie	*Pomoxis annulauris*		X	
Bluegill sunfish	*Lepomis macrochirus*		X	
Green sunfish	*Lepomis cyanellus*	X	X	
Threadfin shad	*Dorosoma petenense*		X	

Water temperature is a very important water quality issue for the Keswick Dam to the RBDD reach of the Sacramento River, primarily because of habitat requirements for salmonids. Four runs of chinook salmon, all of which are listed or are candidates for listing, and Central Valley steelhead trout, which is also listed, spawn and rear in this reach of the river. Maximum survival of incubating salmon and steelhead eggs and yolk-sac larvae occurs at water temperatures between 41 and 56 degrees Fahrenheit, with no survival occurring at 62 degrees Fahrenheit or higher. After hatching, sac fry are completely dependent upon the yoke sac for nourishment and may tolerate water temperatures up to 58 degrees. After juvenile salmon have emerged from the gravel and become independent of the yoke sac, the young salmon are able to tolerate water temperatures up to 67 degrees. Winter-run and spring-run chinook salmon, which lost their historic upper elevation cold-water spawning habitats when Shasta Dam was built, spawn during late spring and summer and, therefore, are particularly vulnerable to water temperature conditions in the river. Winter-run is listed as endangered and spring-run is listed as threatened under the Federal ESA.

For a period after Shasta Dam was constructed, the reservoir was kept relatively full and the cold water released from the hypolimnion (the cold, lower layers of a water body) provided cooler summer temperatures in the downstream reaches. The cold-water releases created suitable conditions for winter-run and spring-run to spawn in the mainstem Sacramento River below Shasta and Keswick Dams. At present, winter-run spawning habitat is almost entirely restricted to the Sacramento River between Keswick Dam and the RBDD and, thus, the survival of winter-run chinook is strongly tied to habitat conditions in this reach. In the 1980s and 1990s, Shasta Lake storage releases were increased to satisfy increasing spring and summer agricultural and urban water demands. The increases depleted the cold-water pool, resulting in warmer water in the river and high moralities of salmon eggs. The NMFS Biological Opinion for winter-run chinook (1993) established water temperature objectives for the river upstream of Jellys Ferry (near RBDD) of 56 degrees Fahrenheit for the period April 15 through September 30, and 60 degrees for October. Recent changes in reservoir operations, including greater carry-over storage, increased imports of cold water from the Trinity River system and, most importantly, the installation of a TCD on Shasta Dam, have substantially improved water temperature conditions in the reach.

Shasta Lake/Tributaries and Keswick Reservoir

The fisheries resources of Shasta Lake are greatly affected by the reservoir's thermal structure. During summer months, the epilmnion (warm surface layer) is 30 feet deep and up to 80 degrees Fahrenheit. Water temperatures above 68 degrees Fahrenheit favor warm-water fishes such as bass and catfish. The deeper water layers, which include the hypoliminion and the metalimnion (transition zone between epilmnion and the hypoliminion) are colder and suitable for cold water species. Shasta Lake is classified as warm monomictic because it has one period of mixing per year.

The warm-water fish habitats of Shasta Lake occupy two ecological zones: the littoral (shoreline/vegetated) and the pelagic (open water) zones. The littoral zone lies along the reservoir shoreline down to the maximum depth of light penetration on the reservoir bottom, and supports populations of spotted bass, smallmouth bass, largemouth bass, black crappie, bluegill, channel catfish and other warm-water species.

The upper, warm surface layer of the pelagic (open water) zone is the principal plankton-producing region of the reservoir. The plankton comprises the base of the food web for most of the reservoir's fish populations. Operation of the Shasta Dam TCD, which helps conserve the reservoir's cold-water pool by accessing warmer water for storage releases in the spring and early summer, may reduce zooplankton biomass, which resides primarily in the reservoir's warmer surface water layer.

The deeper areas of Shasta Lake, hypolimnion and metalimnion, support cold-water species such as rainbow and brown trout and landlocked chinook and kokanee salmon. Native species such as white sturgeon, Sacramento blackfish, hardhead minnow, riffle sculpin, Sacramento sucker and

Sacramento pikeminnow reside in cold water near the reservoir bottom. Trout may congregate near the mouths of the reservoir's tributaries, including the upper Sacramento River, McCloud River, Pit River, and Squaw Creek, when inflow temperatures of these streams are favorable.

The lower reaches of the reservoir's tributaries also provide spawning habitat for reservoir fish populations, particularly trout, and have important resident fisheries of their own. Most of the native species found in the reservoir and listed in the previous paragraph also inhabit the lower reaches of the tributaries. One of the species, the hardhead minnow, is classified as a State of California Species of Special Concern. The McCloud River once supported a population of bull trout, which is currently a State and Federally listed species. A few creeks on the western shore of the reservoir are devoid of biological life because of toxic effluent from local mines.

Sacramento River

The Sacramento River flows for about 59 miles between Keswick Dam and the RBDD. The river in this reach has a stable, largely confined channel with little meander. Riffle habitat with excellent gravel substrates and deep pool habitats are abundant. Immediately below Keswick Dam the river is deeply incised in bedrock with very limited riparian vegetation and no functioning riparian ecosystems. Water temperatures are generally cool even in late summer because of regulated releases from Shasta Lake and Keswick Reservoir. Near Redding, the river comes into the valley and the floodplain broadens. Historically, this area appears to have had wide expanses of riparian forests, but much of the river's riparian zone is currently subject to urban encroachment. This becomes quite extensive in the Anderson/Redding area with homes placed directly within or adjacent to the riparian zone.

The Keswick to Red Bluff reach of the Sacramento River contains a large assemblage of resident and anadromous fish species, including commercially important species and species that are listed as threatened or endangered. The reach produces four separate runs of chinook salmon, which makes it unique among rivers in North America. Despite net losses of gravel since the construction of Shasta Dam, substrates in much of this reach contain gravel needed for spawning by salmonids. This reach provides much of the remaining spawning and rearing habitat of several listed anadromous salmonids. As such, it is one of the most sensitive and important stream reaches in the State.

The salmon that occur in the Sacramento River below Keswick Dam include all four Central Valley runs of chinook salmon: winter-run, spring-run, fall-run and late fall-run. Winter-run chinook is a Federal and State listed endangered species and spring-run chinook is Federally listed as threatened and State listed as endangered. Central Valley fall-run and late fall-run chinook salmon are currently a candidate species for Federal listing. Central Valley steelhead trout, which are Federally listed as threatened also occur in the Sacramento River upstream of Red Bluff and spawn in this reach. Most of these runs historically spawned upstream of the current location of Shasta Dam. With the possible exception of Battle Creek, the Sacramento River and its tributaries above Shasta Dam were the only spawning streams of winter-run chinook salmon. Fortunately, cold water released from Shasta Dam created new spawning habitat in the reach below Keswick Dam. Without these cold-water releases, the winter-run would possibly have been extirpated with the loss of its historic spawning streams. Today, the fall-run, late fall-run and winter-run chinook salmon stocks and the Central Valley steelhead stocks in the Keswick to Red Bluff reach are augmented by production from the Coleman Fish Hatchery on Battle Creek.

In addition to the anadromous salmonids, the Sacramento River contains resident rainbow trout and other native fishes. Resident rainbow trout are particularly abundant in the Keswick to Red Bluff reach. Their abundance has been attributed to stable, cool summer flows resulting from Keswick Dam releases designed to enhance habitat conditions for winter-run salmon. The cool, nutrient-rich flows from the reservoir provide excellent rearing conditions for the trout. Other native species that reside in the Sacramento River upstream of Red Bluff include Sacramento pike minnow, Sacramento sucker and hardhead minnow. White sturgeon and green sturgeon are native anadromous species that have been found at the RBDD. Green sturgeon has been proposed for Federal listing as endangered or threatened.

Vegetation

The Central Valley historically contained an estimated 1,400,000 acres of wetlands. Today, approximately 123,000 acres remain. Riparian and wetland habitats provide food and shelter to aquatic fauna, as well as attenuating high flows. The Sacramento River Valley contains a large diversity of both lowland and upland habitats and species. Along most of the Sacramento River and its tributaries, remnants of riparian communities are all that remain of once productive and extensive riparian areas. However, along the upper reaches of the Sacramento River, a higher percentage of the riparian vegetation is still intact. Vegetation in the river corridor varies from oak/gray pine and chaparral communities with very limited riparian vegetation above Redding to broad riparian ecosystems and agricultural lands from Redding to Red Bluff. Wetlands occupy many areas along Sacramento River waterways, but are not as extensive as wetlands found in the Delta. On the other hand, grasslands and wooded upland communities are more abundant in this region. Agricultural lands also occupy a significant portion of the Sacramento River Basin. Open-water areas occur mainly on the larger waterways, where waterways converge, and in reservoirs.

Shasta Lake and Vicinity

Vegetation in the Sacramento River watershed upstream from Shasta Lake can be separated into seven basic vegetation types: Douglas fir-Mixed Conifer forest, Mixed Conifer, Ponderosa Pine, Canyon Oak Woodland, Black Oak Woodland, Gray Pine Woodland and Chaparral. Elevation ranges for these vegetation types are between 1,065 feet (lake shore) and 5,100 feet (Schell Mountain). This elevation gradient travels through two transition zones: (1) Valley (<1,500 feet) and Lower Montane (Foothill) vegetation types and (2) Lower Montane (1,000 to 3,500 feet) and Montane (>3,000 feet) vegetation types. Plant species diversity is very high.

Lower elevation vegetation consists of a mix of chaparral and hardwoods; mid-elevation slopes are within a transitional zone that contains both the chaparral/hardwood mix and a mixed conifer component; and higher elevation sites are dominated by mixed conifer overstory with brush species in the understory primarily in open areas. An exception to this is in the riparian corridors where conifers can span from lower to upper elevations. Montane riparian is located in narrow belts along many of the tributaries.

Sacramento River

Vegetation in the river corridor varies from oak/gray pine and chaparral communities with very limited riparian vegetation above Redding to broad riparian ecosystems and agricultural lands from Redding to Red Bluff.

Riparian Habitat – Riparian vegetation along the Sacramento River corridor is in the valley foothill riparian association. This habitat has a canopy height of 100 feet with 20 to 80 percent closure. Plant species have specialized adaptations to life in an environment frequently disturbed by flooding and deposition. This vegetative complex provides necessary habitat for many species of native fish and wildlife. Primary native tree species within the riparian forests of the upper Sacramento River include: Fremont cottonwood; White alder; California sycamore; Black walnut; Oregon ash; Red, black and yellow willow; and Valley oak. Numerous native shrubs, vines, grasses and sedges are located within the understory of these trees and, in cases where the tree cover is absent, provide the sole vegetative cover.

Since the river immediately below Keswick is deeply incised in bedrock, there is very limited riparian vegetation and no functioning riparian ecosystems. Near Redding the river comes into the valley and the floodplain broadens and historically had wide expanses of riparian forests. However, the river's riparian zone from Balls Ferry to Keswick is subject to considerable urban encroachment. **Table 7** summarizes existing riparian resources within the 100-year floodplain along the Sacramento River between Keswick Dam and Red Bluff.

TABLE 7
RIPARIAN AND CLOSELY RELATED HABITATS WITHIN THE 100-YEAR FLOODPLAIN ALONG THE SACRAMENTO RIVER BETWEEN KESWICK AND RED BLUFF

Vegetation Type	Acres	Percent of Land Surface Area
Riparian Forests	2,801	15%
Riparian Scrub	1,439	8%
Valley Oak Woodland	315	2%
Marsh	58	<1%
Blackberry Scrub	61	<1%
Total Riparian Vegetation	***4,674***	***26%***

Wetland Habitat – While often combined with riparian ecosystems, wetlands within the project area are defined as shallow to moderately deep open water areas having a vegetative component of emergent and aquatic species (specifically cattails, rushes and sedge). These are normally the result of annual flooding that breaches natural levees along the river, resulting in shallow pools of semi-permanent water. Fairly significant wetland areas exist on tributaries to Shasta Lake and to a limited extent along the Sacramento River downstream to Red Bluff.

Upland Habitat – Upland habitats downstream from Shasta Dam are divided into three categories based on elevation and soil conditions. These include montane hardwood/conifer and blue oak/digger pine (foothill or grey pine) associations from Shasta Dam downstream to Redding, and valley oak woodland adjacent to the river from Redding to Red Bluff. The Montane hardwood/conifer consists of Ponderosa pine, Douglas fir, incense cedar, black oak, Oregon white oak and canyon live oak with relatively little understory. Because of its variety of vegetation and close proximity to other associations, this habitat type provides for a diverse fauna. The Blue oak/foothill pine association is diverse structurally, both horizontally and vertically. The understory shrub layer is sparse and may be limited to annual grassland. The Valley oak woodland association varies from savannah-like to more dense forests with partial canopy-closure. Valley oak woodland is usually associated with conditions where trees can put roots into a permanent water supply, such as along drainages. These woodlands provide abundant food and cover for many species of wildlife.

Wildlife

The composition, abundance, and distribution of wildlife resources in the Sacramento Valley are directly related to available habitat. Overall, fewer wildlife species now inhabit the study area than before agricultural and residential development permanently removed much of the native and natural habitat. Many of the wildlife species are unable to adapt to other habitat types or altered habitat conditions and are, therefore, most susceptible to habitat loss and degradation. Species that were dependent on riparian woodland, oak woodland, marsh, and grassland habitats, have declined accordingly.

Wildlife resources in the primary study area include habitat conditions suitable for over 200 species of birds and 55 species of mammals, reptiles and amphibians. Typical species include owl, raven, gray squirrel, black bear, deer, hummingbird, swallow, elk, ducks, and geese. Lower elevation areas in the McCloud River, Sacramento River, Pit River, and Squaw Creek drainages are also winter ranges for deer. Elk winter range is located in the McCloud River and Pit River peninsulas.

The existing native habitat, especially the riparian corridors along the Sacramento River and associated sloughs and creeks, provide habitat for many native species including blacktail jackrabbit, western gray squirrel, red fox, gray fox, bobcat, raccoon, opossum, mink, longtail weasel, striped skunk, spotted skunk, badger, muskrat, river otter, and beaver. Some amphibians and reptiles found in the study area include the gopher snake, giant garter snake, western fence lizard, common garter snake, and pacific tree frog. Native habitat also provides nesting and feeding habitat for resident birds.

Riparian habitat provide shade, cover, and food supply to the immediate shoreline environment of large rivers, benefiting fish and wildlife species such as salmonids, native fishes, river otter, beaver, herons, egrets, and kingfisher.

Special-Status Species

Sacramento River Basin is home to 65 special-status plant species, nine special-status fish species, and 39 special-status wildlife species. Most of the plant species live in grasslands, including vernal pools. The next-greatest number of special-status species inhabits chaparral and montane hardwood areas. Most of the special-status fish and wildlife species inhabit grasslands, freshwater emergent wetlands, lakes, and rivers on the valley floor. Federal and State wildlife agencies have listed many species.

Plants

Plants considered by the State and/or the FS to require special attention are designated as "sensitive." Plants potentially within the project area under this designation are shown in **Table 8**. There are no known populations of listed plants in the project area.

TABLE 8
POTENTIAL HABITAT FOR SPECIAL STATUS PLANTS IN THE SHASTA LAKE WATERSHED

Species	Status	Habitat	Nearest population to watershed
Arnica venosa Veiny arnica	Endemic	Hot dry slopes under pine, black oak and Doug fir. Usually on north-facing aspects or ridgetops. Elevation: 1,500-5,000 feet.	There are two populations in the primary study area.
Cypripedium faciculatum Clustered lady's slipper	Sensitive	Mixed conifer or oak forests on a variety of soil types, often but not always associated with streams; 1,300-6,000 feet elev. Widespread but sporadic.	No known populations on the Shasta side of the forest. There are several populations on the Trinity side of the forest.
Cypripedium montanum Mountain lady's slipper	Sensitive	Mixed conifer or oak forests on a variety of soil types, often but not always associated with streams; 1,300-6,000 feet elev. Widespread but sporadic.	There is one known population along the Soda Creek Rd., approx. 18 miles northeast of the watershed.
Lewisia cantelovii Cantelow's lewisia	Sensitive	Moist rock outcrops in broad-leaf and conifer forests; elev. 500 to 3,000 feet.	There are two populations near Lamoine, approx. 2 miles north of the watershed.
Neviusia cliftonii Shasta snow-wreath	Sensitive	North-facing slopes on limestone-derived soils, within riparian zones; Elev. 2,400 to 3,000 feet.	3 miles east in Waters Gulch. There is a small amount of limestone outcrop in Big Backbone Creek and Little Backbone Creek.
Source: Shasta Lake West Watershed Analysis, U.S. Forest Service, 2001.			

Fish and Wildlife

Within the primary study area there is the potential for occupancy by twelve species listed as threatened or endangered under the ESA and/or the California Endangered Species Act (CESA). These species (see **Table 9**) are provided protection by one or both of these acts and any actions resulting in take must be permitted by the FWS and the DFG. In addition, the project area has the potential to host species of special concern, also shown in **Table 9**. Species of special concern, while not offered protection under the endangered species acts, require analysis and mitigation under California Environmental Quality Act (CEQA).

TABLE 9
ENDANGERED, THREATENED, AND SPECIAL STATUS FISH AND WILDLIFE SPECIES

Species	Status	Habitat Specifics
Federal and State Threatened and Endangered Species		
Valley elderberry longhorn beetle	FE	Riparian; requires mature elderberry bushes
Chinook salmon (winter-run)	FE, SE	Sacramento River and tributaries
Chinook salmon (spring-run)	FT, ST	Sacramento River and tributaries
Bald eagle	FT,SE	Riparian zones along larger rivers and open water areas w/large trees for nesting and roosting
California red-legged frog	FT	Still or slow-moving water w/shrubby riparian vegetation. Extinct in project area.
Steelhead	FT	Sacramento River and tributaries
Peregrine falcon	SE	Riparian zones for wintering habitat
Yellow-billed cuckoo	SE	Riparian forests greater than 50 acres
Shasta salamander	ST	McCloud River, Pit River, and Squaw Creek in moist limestone fissures and caves
Swainson’s hawk	ST	Riparian areas w/ large trees for nesting; adjacent open lands for foraging
Bull trout	SE, FT	McCloud River
Bank swallow	ST	Steep river banks and bank near water sources
Species of Special Concern		
California tiger salamander	SC	Wetland and vernal pools and adjacent uplands
Foothill yellow-legged frog	SC	Shallow river and streams with gravel bottoms
Western spadefoot toad	SC	Vernal pools and ponds
Western pond turtle	SC	Moderate to deep slow-moving rivers, ponds and streams having deep pools.
Hardhead Minnow	SC	Shasta Reservoir and tributaries
Chinook Salmon (fall/late-fall-run)	SC	Sacramento River and tributaries
Ferruginous hawk	SC	Wintering populations only; grasslands.
Cooper’s hawk	SC	Riparian zones
Sharp-shinned hawk	SC	Riparian zones
Merlin	SC	Riparian zones for wintering habitat
Osprey	SC	Riparian zones along larger rivers and open water areas w/large trees for nesting and roosting
Western least bittern	SC	Marshy areas with emergent vegetative cover
White-faced ibis	SC	Irrigated pastures, shallow marsh
Black tern	SC	Marsh lands w/permanent open water
California gull	SC	Wintering populations only; riverine and wetlands
Long-billed curlew	SC	Grasslands and irrigated pastures
Burrowing owl	SC	Grasslands
Long-eared owl	SC	Riparian habitat w/dense canopies
Short-eared owl	SC	Open areas with few trees; grasslands, irrigated pastures.
Vaux’s swift	SC	Coniferous (Douglas fir) habitats; snags
California horned lark	SC	Grasslands
Loggerhead shrike	SC	Oak woodland
Purple marten	SC	Riparian forests
Tri-colored blackbird	SC	Marsh
Yellow-breasted chat	SC	Riparian scrub
Yellow warbler	SC	Riparian scrub/forests

Key:
FE=Federally endangered, SE=State endangered, FT=Federally threatened, ST=State threatened, SC=Regarded by the FWS and/or CDFG as a species of special concern.

Wild and Scenic

In the Shasta Dam area, the free-flowing stretches of the McCloud River are protected under the California Wild and Scenic River Act of 2002 (Public Resources Code Section 5093.50). Under the act, the State legislature made the finding that "maintaining the McCloud River in its free-flowing condition to protect its fishery is the highest and most beneficial use of water". The act restricts the construction of dams, reservoirs, diversions, or other water impoundment facilities on the McCloud River from the location of the present confluence of the McCloud River with Shasta Reservoir (McCloud Bridge). With the exception of participation by the DWR in studies involving the feasibility of enlarging Shasta Dam, the act prohibits any State department or agency from assisting or cooperating with any agency of the Federal, State, or local government in planning or constructing any facility that could have an adverse effect on the free-flowing condition of the McCloud River or on its wild trout fishery.

Social and Economic Resources

Population

It is estimated that the number of persons living in California as of April 1, 2000 totaled almost 34 million. The 2000 census counted 2.4 million persons residing within Shasta, Tehama, Butte, Glenn, Colusa, Sutter, Yuba, Yolo, Sacramento, and Solano counties. About three-fourths of the population reside in and near the City of Sacramento. Shasta County (the Redding Metropolitan Area) had about 163,300 residents. Population growth during the 1990-2000 decade totaled approximately 4.1 million persons for the State, 328,300 for the greater Sacramento River Valley area, and 16,200 for Shasta County.

Population growth in California has created demands for land and water resources for residential, commercial, and infrastructure uses. As population has increased, urbanization has converted substantial amounts of land from agriculture, wetland, open space, and other land use categories to roads, parks, housing, retail stores, office space, and other urban uses. This has also included increased demand for a more dependable water supply.

Land Use

Land uses in the Sacramento River Valley are principally agricultural and open space, with urban development focused in the Sacramento metropolitan area. Urban development has occurred along major highway corridors, primarily in Sacramento, Placer, El Dorado, Yolo, Solano, and Sutter counties, and has taken some agricultural land out of production. Soil conditions in the basin allow a wide variation in crop mix.

The primary private land use in the region is agriculture. As of 1997, California's 74,126 farms included a total of 27.7 million acres. Of that, the Sacramento River Valley area had over 11,000 farms with about 4.3 million acres. Shasta County's 850 farms encompassed a total of almost 317,000 acres. The region has extensive tracts of Federal and State land, including portions of the Shasta-Trinity, Lassen, Plumas, and Mendocino National Forests plus several Federally- or State-owned wildlife management areas.

Employment and Business/Industrial Activities

It is estimated that in August 2002, California's civilian labor force totaled 17.5 million. During 2001, approximately 1.2 million persons, or half of the persons in the Sacramento River Valley area, were in the civilian labor force. The area's rate of unemployment ranged from 4.1 percent in Solano County to 17.6 percent in Colusa County. For the year 2001, Shasta County had a labor force that averaged 76,487 of whom 71,332 were employed and 5,155 unemployed. This represents an unemployment rate of 6.7 percent.

The State's economy is based on the manufacture of computers and electronic products, transportation equipment (particularly aerospace products), fabricated metal products, machinery, and food processing; business services; and farming. The economy of the central and northern counties in the Central Valley is based on lumbering and the manufacture of wood products, and farming and food processing. In the year 2000, manufacturing establishments employed 74,046 workers in the Central Valley. Shasta County manufacturers accounted for 5,039 of these jobs or 6.8 percent for the area. The manufacturing sector in the Central Valley had sales totaling almost $17.0 billion; and Shasta County's manufacturing establishments earned $635 million.

Shasta County's economy has expanded as the result of the provision of new health service facilities, shopping centers, and recreational services for non-residents of that county. Tourism, recreation, and related hospitality industries are a major source of economic development in the primary study area. In 1998, travel-related spending alone exceeded $360 million in Shasta County, generating over 4,600 jobs. Shasta Lake and the Sacramento River play a central role in the tourism industry and the appeal of the region to prospective businesses and investors.

Local Government and Finance

Local government services in California are provided by counties, school districts, fire districts, water districts, and other special districts. Based on 1997 census data, it is estimated that all local governmental units operating within the 10-county Sacramento River Valley area had revenues totaling almost $8.8 billion or about $3,950 per regional resident. Shasta County's governmental units had combined revenue of about $644 million or $3,983 per resident. Forty-one percent of the combined revenue of all the local governmental units operating within the Sacramento River Valley area was derived from the transfer of State governmental revenue and about 19 percent from local taxes.

Public Health and Safety

Data from the 1997 census indicate that local governmental units operating within the region employed about 4,200 full-time workers and spent about $310 million or $139 per regional resident to provide health and hospital services. Local Governmental units in Shasta County spent about $36 million or $223 per county resident on the provision of public health services. Shasta and Tehama counties are the only jurisdictions in the Sacramento River Valley area in which hospital care is provided by local government.

State Police, County Sheriffs, fire districts, and county-run detention facilities provide public safety in California's rural areas and smaller incorporated places. Larger cities in the State almost always provide police and fire services within their jurisdictions. In 1997, local governments within the Sacramento Valley employed about 7,500 workers to provide police and fire protection. This number included about 5,000 workers for police protection and about 2,400 for fire protection. Shasta County's local governments employed a total of 467 workers to provide public safety, including 364 for police protection and 103 for fire protection. Annual expenditures for public safety in the Sacramento River Valley area totaled $732 million or $329 per regional resident. The provision of public safety in Shasta County cost $48 million or $297 per county resident.

Traffic and Transportation

The major transportation routes in the study area include: Interstate 5, which traverses the valley from north to south; State Route 299, an east-west route, traverses Trinity, Shasta, Lassen, and Modoc counties in the northern watershed areas; and State Route 99 and State Route 70, portions of which are expressway, also run north-south from Sacramento northward toward Chico. The upper watershed areas west and east of the Sacramento Valley contain a network of State highways. Major routes on the west side of the valley include State Route 29, which runs north-south through Napa and Lake counties and several east-west freeways including State Route 20 in Lake County, State Route 162 in Glenn County, and State Route 36 in Tehama and Trinity counties. Excluding Chico, traffic within the central and northern portions of the Central Valley usually is moderate to light. During weekends and holidays from May 1 through Labor Day, however, heavy traffic in the Redding-Shasta Lake area is not unusual.

Recreation and Public Access

Major recreation areas in the Sacramento River Basin include lakes and reservoirs, rivers and streams, Federal wildlife refuges, and State wildlife management areas. Private lands also support considerable waterfowl hunting activity in the region. Shasta Lake, Whiskeytown Lake, Lake Oroville, Folsom Lake, New Bullards Bar Reservoir, and Englebright Lake provide extensive reservoir recreation opportunities, including flat-water recreation.

Information from the 1997 census indicates the importance of outdoor recreation in Shasta County. The county's accommodation and food services establishments had sales totaling $162 million or almost $1,000 per county resident. This per capita amount is the highest of all the counties in the Sacramento River Basin. Outdoor recreation and tourism in Shasta County is the result of Shasta Lake. FS personnel in Redding report that the lake has attracted the development of: 11 marinas with 1,075 houseboats, including 625 that are privately owned and 450 that are owned by a marina and rented on a weekly or weekend basis, and 18 developed public campgrounds with a total of 246 sites. In addition, several of the lake's marinas have developed rental campsites and numerous cabins on land leased from the FS. Access to most of the campgrounds, day-use areas, and marina/resorts around Lake Shasta is provided by Interstate 5 and secondary roads maintained by the FS or Shasta County.

Utilities and Public Services

Various departments within the cities and counties of the Sacramento River Valley provide highly efficient fire protection, police protection, and emergency services to members of their respective communities. There is a vast network of utility generation/transmission systems and service providers cross all regions of the study area, supplying urban and rural areas with power, water, and emergency services. Other significant infrastructure consists primarily of hydroelectric and natural gas-fired generating facilities, transmission lines, substations, distribution lines, fiber optic and cable lines, and communication towers. Pipelines, storage areas, and compressor stations are located in the Sacramento Valley.

Water Supply

On the basis of information contained in the 1998 DWR California Water Plan (Bulletin 160-98), water demands (applied water) in the State in 1995 for urban, agricultural, and environmental purposes under average and drought year conditions amounted to about 79.5 and 65 MAF, respectively. To address this demand, available state-wide supplies from surface water, groundwater, and recycled and desalted sources also under average and drought year conditions amounted to about 78 and 60 MAF, respectively. During average years about 84 percent of the available supplies come from surface water sources and 16 percent from groundwater. In dry years the water from surface water sources decline to about 73 percent of the available supplies and nearly all of the remainder (about 27 percent) comes from groundwater.

Similar conditions existed in the Central Valley. As can be seen in **Table 10**, the estimated 1995 water demands during average and drought years in the Sacramento River, San Joaquin River, and Tulare Lake Basins were about 38.8 and 35.4 MAF, respectively. The total estimated water supply for both average and drought year conditions were about 37.5 and 31.8 MAF, respectively. Total net water demands (or shortages) ranged from about 1.2 to 3.5 MAF for average and drought year conditions, respectively.

As mentioned, the largest water supply provider in the Central Valley is the CVP. The total annual contract water amount in the CVP is about 8.3 MAF. However, the project can only deliver portions of this amount depending on various conditions. As presented in Bulletin 160-98, the CVP has a 7 MAF delivery capability under average year conditions. Of this 7 MAF, 3 MAF is in the Northern (Sacramento) CVP System, 2.7 MAF in the Southern (San Joaquin) CVP System, and 1.3 MAF in the Eastside and Friant Divisions. On the basis of more recent system modeling runs, however, it is estimated that the system delivery capability under average year conditions and year 2000 demands is about 10 percent less, at an estimated 6.3 MAF. If this is true, then the potential shortages in **Table 10** are significantly larger than previously estimated.

Figure 4 shows the expected frequency that the Northern and Southern CVP Systems can meet estimated annual deliveries under current (2000) conditions. As can be seen, under year 2000 demand conditions in 80 percent of the years it is estimated that the system can deliver at least 4.5 MAF and in 20 percent of the years at least 5.8 MAF. The median annual delivery (50 percent exceedence) is about 5.5 MAF.

TABLE 10
YEAR 1995 - ESTIMATED WATER DEMANDS, SUPPLIES, AND SHORTAGES
(1,000 ACRE-FEET)

Water Condition	Hydrologic Basin						Three Basin Total	
	Sacramento River		San Joaquin River		Tulare Lake			
	Average Year	Drought Year	Average Year	Drought Year	Average Year	Drought Year	Average Year	Drought Year
Applied Water								
Urban	766	830	574	583	690	690	2,030	2,103
Agricultural	8,065	9,054	7,027	7,244	10,736	10,026	25,828	26,324
Environmental	5,833	4,223	3,396	1,904	1,672	809	10,901	6,936
Total	14,664	14,107	10,997	9,731	13,098	11,525	38,759	35,363
Water Supply								
Surface Water	11,881	10,022	8,562	6,043	7,888	3,693	28,331	19,758
Groundwater	2,672	3,218	2,195	2,900	4,340	5,970	9,207	12,088
Recycled/Desalted	0	0	0	0	0	0	0	0
Total	14,553	13,240	10,757	8,943	12,228	9,663	37,538	31,846
Shortage	***111***	***867***	***240***	***788***	***870***	***1,862***	***1,221***	***3,517***

Source: The California Water Plan, Bulletin 160-98, Appendix 6A, Regional Water Budgets with Existing Facilities and Programs, November 1998.

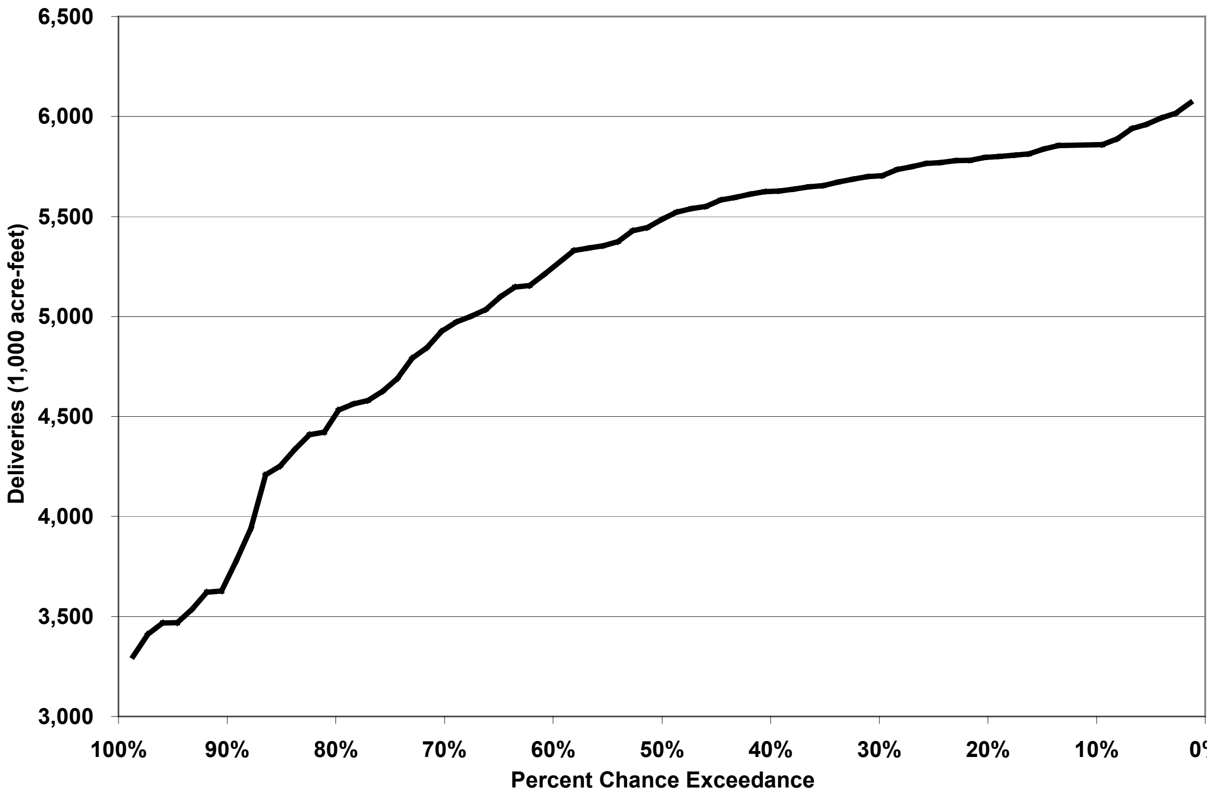


Figure 4 – Estimated Frequency (Percent Exceedance) of Total CVP Deliveries in the Northern and Southern CVP Systems (Excluding Madera and Friant-Kern Systems) with Year 2000 Level Demands and D-1485 Requirements

When deficiencies in the ability of the system to deliver full entitlements occur as indicated in **Table 10** and **Figure 4**, deliveries are reduced by varying percentages based on demand type (i.e., refuges, settlement contracts, and CVP contracts). The priority deliveries include wildlife refuges north and south of the Delta and water required by the CVP Exchange and Settlement Contractors. The discretionary deliveries, which can be significantly shorted depending on the type of water year, include agricultural and M&I CVP contractors both north and south of the Delta.

Power/Energy

Major energy generators in the study area include the SWP, CVP, and private suppliers. The primary purpose of the SWP power generation facilities is to meet energy requirements for the SWP pumping plants. To the extent possible, SWP pumping is scheduled during off-peak periods, and energy generation is scheduled during on-peak periods. Although the SWP uses more energy than it generates from its hydroelectric facilities, DWR has exchange agreements with other utility companies and has developed other power resources. When available, surplus power is sold by DWR to minimize the net cost of pumping energy.

CVP power generation facilities initially were also developed based on the premise that power could be generated to meet project use loads. The Reclamation Act of 1939 provided for surplus power to be sold first to preference customers, including irrigation and reclamation districts, cooperatives, public utility districts, municipalities, and large educational or government facilities. Surplus commercial power may be sold to non-preference utility companies.

The California Independent Systems Operator (ISO) synchronizes all major electrical loads and generators within the State boundaries to operate as a single cohesive system. In addition to the California ISO, there is a much broader system of electric generation and transmission with which the CVP and SWP interact called the Western Systems Coordinating Council (WSCC). These interactions with the WSCC could extend over the entire West Coast and inland to the desert regions of the Southwest.

Other major hydroelectric facilities present in the study area are investor-owned utility companies, such as PG&E and Southern California Edison (SCE); by municipal agencies, such as the Sacramento Municipal Utility District (SMUD); and by several water and irrigation districts. Some of the larger facilities outside the CVP and SWP systems in the Sacramento Valley area include PG&E’s Pit System (317 MW) and McCloud-Pit System (340 MW) in Shasta County, PG&E’s Upper North Fork Feather River System (340 MW) in Plumas County, SMUD’s Upper American River Project System (640 MW) in El Dorado County, and Yuba County Water Agency’s Yuba River Project (300 MW) in Yuba County.

Hazardous Materials and Waste

Types of hazardous waste sites in the Sacramento River Basin include contaminated agricultural ponds; hazardous materials spills; and leaking tanks or pipelines from industrial sites, railroad operations, commercial sites, and mining. Metals such as cadmium, copper, mercury, and zinc, are present in inactive and abandoned mines in the Sacramento River drainage. Inactive underground mines and surface waste piles at Iron Mountain, California, in the Clear Creek watershed, have extremely acidic drainage with high concentrations of toxic discharges and metals.

Fire Hazard

Fire suppression policies and large-scale grazing have caused the rate of material decomposition to decline dramatically, and have led to fuel accumulation throughout most of the wild lands of the Sacramento River Basin. Fire suppression efforts also have reduced the frequency of wildfires and greatly reduced the land areas impacted by the fires.

Natural Resources

The State's scenic beaches and mountains, mild climate, extensive rivers with cold-water fisheries, fertile soil, and forested areas have been a major factor behind the in-migration of persons from other areas. The soil and climate of the Central Valley have brought about its development as a major agricultural area specializing in fruits, vegetables, rice, and other farm products. Farm production, in turn, has stimulated the development of food processing establishments as well as businesses that provide services for the area's farms. Similarly, extensive timber resources have been the catalyst behind the growth of its lumber and wood products manufacturing. The development of Shasta Lake has resulted in Shasta County becoming a major outdoor recreational area, which attracts significant numbers of recreationalists who reside outside of Shasta County.

Aesthetics

Visual resources in the Sacramento River Valley are characterized by agricultural uses in the Sacramento Valley, grasslands and woodlands in the foothills, and forests in the upper watersheds. The Sacramento Valley's upper watershed retained its predominantly oak woodland, grasslands, forests, and small rural communities despite substantial development along Federal and State highways in the foothills and mountain areas. These areas are framed by the forested ridgelines of the Sierra Nevada to the east, the Cascade Range to the north, and the Coast Ranges to the west. Little urbanization in these areas has preserved pristine wildernesses, mountains, and other dramatic landscapes.

Shasta Lake added visual variety to this region. Viewer sensitivity is high in this area because of high recreation use and easy public access. A scenic highway is a road designated by the State or local agencies as having exceptional scenic qualities or affording panoramic vistas. Highway 151 (from Shasta Dam to near Summit City) is officially designated a State scenic highway.

Cultural Environment

Paleontology

California is geologically diverse, with metamorphic and both intrusive and extrusive igneous rock formations as well as a wide range of fossil-bearing sedimentary rock formations. Within the Shasta Lake area, there are both metasedimentary and metavolcanic formations, and more recent volcanic deposits as well. Sedimentary deposits are prominent in the area. The Triassic Hoselkus Limestone contains both marine invertebrates such as ammonites, and marine vertebrate remains including icthyosaurs and thallatosaurs. Solution caves in the Permian McCloud Limestone contain a significant Pleistocene fauna, including remains of horses, bison, giant bears, dire wolves, ground sloths, and mammoths.

Archaeology

California is rich in both prehistoric and historic archaeological remains. The Central Valley has been an especially productive region, with many deeply stratified sites that have produced information of crucial importance in understanding the prehistory of the state. The Shasta Lake area was little known until quite recently; on into the 1950s it was believed that the area was unoccupied prior to AD 900, after which the Shasta area was occupied primarily by ancestors of the Wintu people. Subsequent investigations revealed repeated occupation of the area as early as 8,000 years ago. Archaeological remains also represent ancestors of the Yana people. Historic archaeological sites represent remains from various historic era activities in the Shasta Lake region, especially relating to fur trapping, mining, early settlement and agriculture (farming and ranching).

The Shasta Reservoir area has been surveyed for archaeological remains on numerous occasions. Thirty-seven sites were recorded in the 1940s prior to construction of Shasta Dam, but it is doubtful that this constituted an intensive survey by contemporary standards. During a drought in 1976-1977, the FS revisited previously recorded sites, and surveyed areas usually inundated, but again it is unclear whether this was a complete survey. Areas above gross pool apparently have been surveyed haphazardly and are highly incomplete.

From available information, it is estimated that there are at least 118 archeological sites believed to be inundated by Shasta Reservoir at gross pool elevation (1,076 feet). Of these, an estimated 76 sites are below gross pool but above the minimum pool elevation (840 feet). Of the 118 sites, the great majority (101) are prehistoric sites. There are also 7 historic sites and 10 multi-component (prehistoric/historic) sites. Around the reservoir to elevation 1,276 feet, there is estimated to be another 55 archeological sites. Of these, 50 are prehistoric sites, 4 historic sites, and 1 multi-component site.

History

Northern portions of the Central Valley are largely unmentioned in records of the Spanish and Mexican-era activities which occurred in the more southerly coastal portions of the state. The earliest historic records pertaining to the Shasta Lake area are from Hudson’s Bay Company fur trappers. Malaria, introduced by fur trappers in the area, had devastating effects on aboriginal populations. Gold, copper and iron mining were important activities in the Shasta Lake area during the latter half of the nineteenth century, and later activities included settlement by farmers and ranchers. Most known historic archaeological sites are related to mining, transportation, commerce and recreation.

Historic sites include historic buildings and lodges and historic hiking and fishing trails. On the McCloud River, a private fly-fishing club has been in operation since 1904. Its lodges date from the 1860s. Some lodges are likely eligible for inclusion in the registers of national and State historic structures.

Ethnography

California is home to many linguistically and culturally diverse Native American groups. Within the Shasta Lake area, archeological and ethnographic sites include Indian villages, locations where ceremonies were held, burial grounds, and a number of other types of sites. Large portions of the Sacramento River, McCloud River, and Squaw Creek watersheds were known to have populations of the Wintu Tribe. Sites are known to occur on lands adjacent to Shasta Lake. The Wintu is a group whose language belongs to the Penutian family. These people are believed to have arrived in California around 1,000 BC. The Wintu lived primarily in large villages along the rivers in their territory; they fished for Chinook salmon in the McCloud and Sacramento rivers, and hunted deer and other animals. They also ate large quantities of acorns and other vegetable foods. Several local groups lived within the Shasta Lake area, including the *Nomtipom*, the *Winnemem*, and the *Waimuk*.

The Okwanuchu were another group, related to the Hokan-speaking Shasta people of southern Oregon, who lived in the McCloud River drainage. Another distinct group was the *Madesi* band of Achumawi, farther east along the Pit River. In addition, the Central Yana people held territory in the Cow Creek drainage.

Numerous sacred sites are located immediately above the existing gross pool of Shasta Reservoir. These include burials and cemeteries, places of spiritual power, named villages, and other sites of special concern. The California Native American Heritage Commission identified a number of locations of particular concern.

FUTURE WITHOUT-PROJECT BASELINES

Identification of the magnitude of potential water resources and related problems and needs in the study area is not only based on the existing conditions above, but also on an estimate of how these conditions may change in the future. Two baseline were identified to help define the extent of potential resources problems/needs and for use in identifying the relative effectiveness of alternative plans to be formulated to address these problems/needs. They include:

- **CEQA Baseline –** This baseline is important for developing the Environmental Impact Report (EIR) to meet requirements of CEQA. Under this baseline, future conditions are assumed to be equal to existing conditions.

- **National Environmental Policy Act (NEPA) Baseline –** Under this without-project future condition, only actions reasonably expected to occur in the future would be included. This would include projects and actions that are currently authorized, funded, permitted, and/or highly likely to be implemented. The NEPA Baseline is important for developing the Environmental Impact Statement (EIS) to meet the requirements of NEPA. The NEPA Baseline includes the CEQA Baseline for existing conditions.

Projecting what may happen in the future, without a potential action to resolve the problems/needs identified in the study, is complicated by ongoing programs and projects primarily related to CALFED and the CVPIA. Accordingly, although not authorized or under construction, ongoing ecosystem restoration efforts are likely to be implemented through various small projects. Collectively these efforts would improve the quantity and value of freshwater emergent marsh, scrub-shrub, riparian, oak woodland, annual grasslands, agricultural habitat, wildlife, fishery and aquatic resources, and special–status species. Much of this improvement would be based on separate opportunities that are not integrated in a single plan.

Several significant projects that are expected to be implemented in the future in and near the primary study area and to be included in the NEPA Baseline (for consideration in both conditions with or without a modification of Shasta Lake) include:

- **Sacramento River National Wildlife Refuge –** Land acquisition and habitat restoration program along the Sacramento River between Colusa and Ord Bend.

- **Folsom Modifications –** Enlarging the existing outlets and constructing new low level outlets to increase the releases during lower pool stages, and revising the surcharge storage space in the reservoir.

- **Environmental Water Account (EWA) –** As mentioned, the EWA is a cooperative short-term management program to provide protection to fish of the Bay-Delta estuary through changes in SWP/CVP operations at no uncompensated water costs to the projects' water users. The program appears to be very successful and it is believed that some form of it will continue into the long-term future.

- **Water Use Efficiency –** CALFED seeks to accelerate the implementation of cost-effective actions of their water use efficiency program to conserve and recycle water throughout the State. As with the EWA, it is believed that some form of this program will develop and continue into the long-term future.

- **South Delta Improvements –** One of the potential South Delta Improvement projects included in the CALFED Conveyance program is increasing the SWP pumping criteria to 8,500 cfs during certain periods. Although the potential project is still in the planning phase and not yet approved, it will be included as a without-project condition in future studies. This is primarily because it is an essential element of the ROD, has significant funding allocated under California Proposition 13, and broad state and Federal agency support.

- **Trinity River Restoration Plan** – It is expected that over time, the elements of the December 2000 ROD for the Trinity River Restoration Plan will be implemented. This includes reducing annual exports of the Trinity River water to the Sacramento River from 74 percent of the Trinity River flow to 52 percent.

- **Phase 8 Short-Term Agreement** – It is highly likely that some of the 45 projects identified in the Phase 8 Short-Term Settlement Agreement will be implemented. This includes a portion of the 185,000 acre-feet of water for environmental needs. It is likely that the portion of this water not requiring construction of new infrastructure will be made available.

- **Other Projects** – There are various other projects and programs that are expected to be implemented in the future. Several include the Battle Creek Restoration Project, CVP Contract Renewals, and further implementation of the CVPIA (b)(2) water accounting.

FUTURE WITHOUT-PROJECT CONDITIONS

Summarized below are some of the expected physical, environmental, and socio-economic conditions generally expected to occur in the future.

Physical Environment

Basic physical conditions in the study area are expected to remain relatively unchanged in the future. No changes to area topography, geology, soils, and seismicity are foreseen. From a geomorphic perspective, on-going restoration efforts along the rivers are expected to marginally improve natural riverine processes. Without major physical changes to the river systems, which is unlikely, hydrologic conditions will likely remain unchanged. There is some speculation that the region's hydrology could be altered should there be significant changes in global climatic conditions. Scientific work in this field of study is continuing.

Much effort has been expended to control the levels and types of herbicides, fungicides, and pesticides that can be used in the environment. Further, efforts are underway to better manage the quality of runoff from urban environments to the major stream systems. However, water quality conditions are expected to generally remain unchanged and similar to existing conditions. Most of the air pollutants in the study area will continue to be influenced by both urban and agricultural land uses. As the population continues to grow, with about 4 million additional people expected in the Central Valley by the year 2020, and agricultural lands are converted to urban centers, a general degradation of air quality conditions could occur.

Biological Environment

Significant efforts are underway by numerous agencies and groups to restore various biological conditions throughout the study area. This includes elements of the CALFED programs, Upper Sacramento River Conservation Area program, efforts by The Nature Conservancy and other private conservation groups, and numerous other programs and projects. Accordingly, major areas of wildlife habitat, including wetlands and riparian vegetation areas, are expected to be protected and restored. However, as population and urban growth continues and land uses are converted to urban centers, many of the wildlife species especially dependent on woodland, oak woodland, and grassland habitats may be impacted.

Efforts are also underway to implement programs and projects to help restore fisheries resources. Although significant increases in anadromous and resident fish populations in the Sacramento River are likely to continue through implementation of projects such as the Battle Creek Restoration Project, some degradation will likely occur through actions such as reduction in Sacramento River flows and resulting elevated water temperatures due to reduced diversions of cooler water from the Trinity River. Accordingly, populations of anadromous fish are expected to remain generally similar to existing conditions.

Through the significant efforts of Federal and State wildlife agencies, populations of Special-Status Species in the riverine and nearby areas will generally remain as under existing conditions.

Social and Economic Environment

The population of the State is estimated to increase from 37 million in 2000 to about 49 million by 2020. The population of the Central Valley is expected to increase from approximately 7 million people in 2000 to about 11 million people by 2020. In the Sacramento River region, the population is expected to increase from about 3 million to about 4.1 million by 2020. To support the expected increase in population, some conversion of agricultural and other rural land to urban uses is anticipated. To accommodate the increasing population, modification of existing major traffic corridors is also anticipated. Increased transportation routes are likely to be constructed to connect the anticipated population increase in the Central Valley to existing transportation infrastructure.

The anticipated increases in population growth in the Central Valley will result in increased demands on water resources systems for additional and reliable water supplies, energy supplies, water-oriented facilities, recreational facilities, and flood damage reduction facilities.

Table 11 summarizes Bulletin 160-98 estimated water demands (applied water), supplies, and potential shortages for year 2020 levels of demand in the Sacramento, San Joaquin, and Tulare hydrologic basins of the Central Valley. As shown in the table, estimated future shortages of water supplies are expected to be nearly 0.9 MAF in average years and 3.6 MAF in drought years. It is believed, however, based on updated system modeling that the CVP system may only be capable of delivering about 90 percent of that projected in Bulletin 160-98. Accordingly, it is believed that the potential water shortages under year 2020 demands and average and drought year conditions would likely be significantly greater than shown in **Table 11**.

TABLE 11
YEAR 2020 - ESTIMATED WATER DEMANDS, SUPPLIES, AND SHORTAGES
(1,000 ACRE-FEET)

Water Condition	Hydrologic Basin						Three Basin Total	
	Sacramento River		San Joaquin River		Tulare Lake			
	Average Year	Drought Year	Average Year	Drought Year	Average Year	Drought Year	Average Year	Drought Year
Applied Water								
Urban	1,139	1,236	954	970	1,099	1,099	3,192	3,305
Agricultural	7,939	8,822	6,450	6,719	10,123	9,532	24,512	25,073
Environmental	5,839	4,225	3,411	1,919	1,676	813	10,926	6,957
Total	14,917	14,283	10,815	9,608	12,898	11,444	38,630	35,335
Water Supply								
Surface Water	12,196	10,012	8,458	5,986	7,791	3,593	28,445	19,591
Groundwater	2,636	3,281	2,295	2,912	4,386	5,999	9,317	12,192
Recycled/Desalted	0	0	0	0	0	0	0	0
Total	14,832	13,293	10,753	8,898	12,177	9,592	37,762	31,783
Shortage	***85***	***990***	***62***	***710***	***721***	***1,852***	***868***	***3,552***

Source: The California Water Plan, Bulletin 160-98, Appendix 6A, Regional Water Budgets with Existing Facilities and Programs, November 1998.

The anticipated increases in population growth will also have impacts on visual resources within the Central Valley, as areas of open space on the valley floor are converted to urban uses. These increases will also result in increased demands for electric, natural gas, water, and wastewater utilities; public services such as fire, police protection, and emergency services; water-related infrastructure; and communication infrastructure. Further, the increasing population will increase the potential for hazardous toxic radiologic waste issues in the future. It will also place pressures on preservation of existing historical and pre-historical cultural sites within the study area.

The increase in population and aging 'baby boomer' generation will increase the need for health services. During the 2000-2010 decade, many workers will reach 60 years and older. The general migration of retirees and older Americans from colder northeastern regions to warmer southern regions is expected to continue. While many of the region's high school graduates will leave the area for colleges and jobs located in San Francisco and southern California, the region's superior outdoor recreational opportunities and moderate housing costs are expected to attract increasing numbers of retirees from outside the region. Increasing numbers of residents, in turn, will produce increased employment gains, particularly in the retail sales, personal services, finance, insurance, and real estate sectors.

Cultural Environment

Any paleontological, historic, or ethnographic resources currently being affected by erosion due to reservoir fluctuations would continue to be impacted. Fossils and artifacts located around the perimeter of the existing reservoir will continue to be subject to collection by recreationalists. Resources located within the potential inundation zone of an enlarged Shasta Lake will likely be unaffected.